Pipe and North Pipe lakes
Fisheries Assessment, 2015
Polk County, WI

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Executive Summary

Pipe and North Pipe lakes were surveyed during 2015 to assess the abundance and population demographics (i.e., size and age structure, growth, and recruitment) of sport fish, and make comparisons with previous surveys. The fish community of Pipe and North Pipe lakes has changed considerably over the last two decades, with the most notable changes being the walleye and smallmouth bass populations have decreased, while the largemouth bass population has greatly increased. The adult walleye population estimate was 288 or 0.8 fish/acre (95% C.I. = 207-368), which was less than the 2004 survey when it was estimated at 421 or 1.2 fish/acre (95% C.I. 301-540). The walleye population had moderate size structure, improved growth, and the sex ratio was skewed toward females. Although these lakes have some walleye natural reproduction, the level is minimal and the fishery is dependent upon stocking. Large fingerling (6-8 in) walleye have been recently stocked into Pipe Lake, but it is still too early to truly evaluate those stockings. The current walleye stocking regime (10 fish/acre on an alternate year basis) should continue, with the goal of creating a moderate density walleye fishery of 1.5-2 adults/acre. A better evaluation of the large fingerling stockings should be made during the next comprehensive survey. The largemouth bass population has increased despite having a liberalized bass regulation. The largemouth bass population was 3,442 or 10.1 fish/acre (95% C.I. = 2,597-4,287), and the population was characterized as having a high density, low size structure and poor growth rates. Anglers are encouraged to continue to harvest largemouth bass, especially those less than 14 in. If the number of small (<14 in) largemouth bass can be reduced, the size structure and growth rates of the largemouth bass population should improve. Pipe Lake once had an abundant smallmouth bass fishery that served as a popular and unique sport fishery in an area with few smallmouth bass lakes. However, the smallmouth bass population has declined considerably and largemouth bass are now more abundant than smallmouth bass. If the largemouth bass population could be reduced through angler harvest, and the smallmouth bass population was protected with a more restrictive regulation perhaps the smallmouth bass population would increase. A higher length limit could protect the size structure and potentially help increase the smallmouth bass population.

Introduction

Pipe and North Pipe Lake are two connected seepage lakes located in eastern Polk County, west of the City of Cumberland. Pipe Lake is 270 acres and has 5.1 miles of shoreline and a maximum depth of 68 ft. North Pipe is 55 acres and has 1.8 miles of shoreline, and maximum depth of 37 ft. Boat navigation and fish passage is unrestricted though the navigable channel between the two lakes. Although the two lakes are connected, they vary greatly in productivity and water clarity; Pipe Lake is considered mesotrophic and North Pipe Lake is considered eutrophic. Pipe Lake is one of the best lakes in Polk County in terms of water quality, whereas North Pipe is more similar to other Polk County lakes. Much of the shoreline on both lakes is developed, except for the state-owned islands on the south end of Pipe Lake.

The fish community of Pipe and North Pipe lakes consists of walleye *Sander vitreus*, northern pike *Esox lucius*, largemouth bass *Micropterus salmoides*, smallmouth bass *Micropterus dolomieu*, bluegill *Lepomis macrochirus*, black crappie *Pomoxis nigromaculatus*, green sunfish *Lepomis cyanellus*, yellow perch *Perca flavescens*, rock bass *Ambloplites rupestris*, white sucker *Catostomus commersoni*, and bullheads *Ameiurus spp*.

Walleye have been the only species stocked into Pipe and North Pipe lakes in recent decades (Table 1). Although walleye are not native to Pipe and North Pipe lakes (Becker 1983), they were first stocked in 1933. Walleye stocking from 1933-1974 consisted of sporadic fry or small fingerling (< 3 in) stockings, but walleye stocking ceased in 1974 because the lakes had adequate natural reproduction to sustain the walleye fishery. Walleye stocking recommenced in 1994, following several years without a naturally-reproduced year-class (Cornelius 1997). Since 2009, large fingerling (6-8 in) walleye have been stocked into these lakes on an alternate year basis. Pipe and North Pipe are currently considered stocking-dependent walleye lakes, but a low level of natural reproduction does occur, but not enough to sustain the population.

Anglers have access to the lakes by a public boat landing on the north end of Pipe Lake (Figure 1). The walleye regulation is an 18-in minimum length limit (MLL) with a 3-fish daily bag limit and the bass regulation is a no minimum length limit and five fish

daily bag limit. All other species regulations follow the Wisconsin statewide fishing regulations.

Pipe and North Pipe lakes are on a 9-year rotation for comprehensive surveys. Previous Wisconsin DNR fish surveys, which included walleye population estimates, were conducted in 1989, 1995, and 2004. Historic fall electrofishing surveys from 1989-2015 were used to assess walleye stocking efficacy. During the most recent comprehensive survey report in 2004-2005, the fishery was characterized as having a low density walleye population (P.E.= 1.2 adult fish/acre), an abundant largemouth bass population, a quality smallmouth bass population, and bluegill and black crappie populations that provided a majority of the recreational angling effort and harvest (Benike 2006). Management recommendations called for changing the bass regulation to a more liberal regulation to reduce largemouth bass abundance.

The objectives of this survey were to assess the status of the walleye population as part of the treaty assessment sampling rotation of lakes for the Ceded Territory of Wisconsin and assess the abundance and population demographics (i.e., size and age structure, growth, and recruitment) of other sport fish in Pipe and North Pipe lakes and make comparisons with previous surveys.

Methods

Field Sampling:

The sport fisheries in Pipe and North Pipe lakes were sampled in 2015 with early spring fyke netting, early spring and late spring electrofishing, and fall electrofishing (Table 2).

Population abundance of adult walleye was estimated using mark and recapture methodology during the early spring netting and early spring electrofishing surveys. Walleye were considered adult fish if they were ≥15 in or otherwise sexable (i.e., extrusion of eggs or milt; Cichosz 2015). Abundance of adult walleye was estimated using Chapman's modification of the Petersen single-census method (Ricker 1975):

$$N = \frac{(M+1)(C+1)}{(R+1)} - 1$$

where N = population estimate; M = the number of fish marked in the first (marking) sample; C = the total number of fish (marked and unmarked) captured in the second (recapture) sample; and R is the number of marked fish captured in the second sample.

Walleye were captured with fyke nets set at ice out. Fyke nets were set April 2, 2015 and checked every 24-h for 7 days. Fyke nets had 4 x 6 ft. frames, 0.5-in bar measure mesh, and lead lengths of 75 ft. or less. All walleye collected in fyke nets were measured to the nearest 0.5-in TL and sexed. Walleye were marked with differential fin clips between the two lakes. Aging structures were collected from five walleye of each sex per 0.5-in length group. Scales were taken from walleye <12 in and dorsal spines were taken from fish ≥12.0 in. For the recapture period, walleye were collected by boat AC electrofishing along the entire shoreline of the lake with two dip netters at night. All walleye were measured, sexed, and checked for marks.

Population abundance of adult (≥ 8in) largemouth bass and smallmouth bass were estimated using mark and recapture methodology. Bass were marked during the early spring netting survey and by daytime electrofishing. The late spring electrofishing survey served as the recapture event. The entire shoreline was sampled and all bass were measured and checked for marks. Abundance of adult largemouth bass was also estimated using Chapman's modification of the Petersen single-census method (Ricker 1975).

Bass and panfish were assessed by boat AC electrofishing at night along the shoreline during June 1-2, 2015 with two dip-netters. There were three 1.5-miles (or less) gamefish transects in which only gamefish were collected, and four 0.5-mile index transects in which all species were collected. Weights and scale samples were collected from five fish per 0.5-in length group for age and growth analysis.

The year-class strength of age-0 walleye was assessed with fall boat AC electrofishing at night with two dip-netters. The entire shoreline was sampled and all walleye, largemouth bass, and northern pike were netted. Scale samples were collected from walleye <12 in. The catch per effort (CPE) of age-0 walleye and age-1 walleye was

determined by catch per mile and compared to previous fall evaluations. Largemouth bass were also collected during the fall electrofishing survey. Comparisons were made with previous fall electrofishing surveys.

Population Demographics:

Scale samples were pressed on acetate slides and age was assessed on a microfiche reader by a single interpreter. Dorsal spines were mounted in plastic, cut with a Dremel saw and age interpreted on a microfiche reader by a single interpreter. Mean length-at-age comparisons were made with previous surveys, the Barron and Polk County averages, and the regional (18 county WDNR Northern Region) averages obtained from the WDNR Fisheries and Habitat database. Sex-specific aging data were pooled for making comparisons with county and regional averages.

The von Bertalanffy (1938) growth model was determined using mean length at age data to assess growth for walleye and largemouth bass using the following equation:

$$L_t = L_{inf}(1\text{-}e^{-k(t-t0)})$$

Where L_t is length at time t, L_{inf} is the maximum theoretical length (length infinity), e is the exponent for natural logarithms, k is the growth coefficient, t is age in years, and t_0 is the age when L_t is zero.

L_{inf} predicts the average ultimate length attained for fish in that population. Growth equations were calculated separately for each sex due to sex-specific growth differences.

Instantaneous mortality (Z) and annual mortality ($A = 1\text{-}e^{-Z}$) were estimated using a catch curve regression fitted to those ages fully recruited to the gear (Miranda and Bettoli 2007).

Proportional size distribution (PSD) indices were used to describe population size structure of walleye, northern pike, and largemouth bass (Guy et al. 2007). PSD values represent the percent of fish stock length or larger that are also larger also longer than a specified length (Appendix Table 1). The Fisheries Assessment Classification Tool (FACT) was used to determine how PSD values for largemouth bass and walleye compared to those from similar waterbodies throughout Wisconsin. In addition, the CPE for 8, 12, and 15 in (i.e., CPE8, CPE12, and CPE 15) largemouth bass were compared to similar waterbodies in Wisconsin. Relative Weight (*Wr*) was used to assess the condition

level of gamefish species using their standard weight equations (Willis 1989; Murphy et al. 1990; Anderson and Neumann 1996). Relative weight is the ratio of a fish's weight to the weight of a ''standard'' fish of the same length.

Results

Early spring fyke netting and electrofishing

Walleye. We fished up to 8 fyke nets for 7 nights in Pipe Lake, which totaled 56 net-nights. We fished 3 fyke nets for 6 nights in North Pipe Lake which totaled 18 net-nights. The walleye catch rate was 2.6 fish/net-night in Pipe Lake and 3.1 fish/net-night in North Pipe Lake. In total, we collected 175 walleyes fyke netting (Figure 2), 160 of which were adults that received marks. There were 51 males, 79 females, and 30 unknown sex walleye in the sample.

The adult walleye population estimate for Pipe and North Pipe lakes combined was 288 or 0.8 fish/acre (95% C.I. = 207-368; Figure 3), which was less than the 2004 survey when it was estimated at 421 or 1.2 fish/acre (95% C.I. 301-540). When looking at the lakes individually, the density of walleye was less in Pipe Lake than in North Pipe Lake. The Pipe Lake adult walleye population estimate was 197 or 0.7 fish/acre (95% C.I. = 120-273), whereas, the adult walleye population estimate for North Pipe Lake was 82 or 1.4 fish/acre (95% C.I. = 54-110).

Size structure of walleye was moderate between the two lakes. Walleye PSD from netting was 96 ± 3, PSD-P was 24 ± 7, and PSD-M was 3 ± 3 (Figure 4). These size structure indices were similar to previous netting surveys. When compared to statewide trends, the indices were also moderate; walleye PSD was in the 81st percentile, PSD-P was in the 45th percentile, and PSD-M was in the 33rd percentile. The male: female ratio was 0.7:1. Mean length of adult walleye (sexes pooled) from fyke netting was 18.6 in. The mean length of male walleye was 18.9 in and the mean length of female walleye was 19.0 in. Walleye *Wr* was 101, which suggested walleye were in good condition.

The mean length at age for walleye (sexes pooled) has increased in Pipe and North Pipe lakes from the 1995 and 2004 surveys. The mean length at age of age-4 to age-10 walleye during this survey averaged 1.8 and 1.0 inches more than the 1995 and 2004 surveys, respectively (Table 3). Mean length at age for age-4 to age-10 walleye

was similar to the Barron and Polk County average, but averaged 1.5 in more than the Northern Region average. Growth of walleye appeared to slow after age 10, because Age-11 to age-14 walleye averaged 1.2 and 1.3 inches less than the Barron and Polk and Northern Wisconsin averages, respectively.

Mean length at age of female walleye was greater than male walleye across all ages (Figure 5). The predicted length infinity (L_{inf}) from the von Bertalanffy growth model was 27.8 in for female walleye, and 21.9 in for male walleye.

Walleye ages ranged from 1 to 14, male walleye ranged from age 3 to 14 and females ranged from 4 to 14. The catch curve regression model (fitted to age 4 to age 14) estimated annual mortality to be 19.2% ($Z= -0.21$, $R^2 = 0.27$; Figure 6).

Northern Pike. Catch of northern pike was low during the spring fyke netting surveys. There were 67 northern pike collected between the two lakes (Figure 7). The catch rate was 0.8 fish/net-night in Pipe Lake and 1.4 fish/net-night in North Pipe Lake. The catch rate for both lakes combined was 0.9 fish/net-night, which was less than the 2004 fyke netting catch rate (2.6 fish/net-night).

The size structure of northern pike was average, but larger fish were also collected. Northern pike PSD from netting was 46 ± 12, PSD-P was 8 ± 7, and the PSD-M was 3 ± 4 (Figure 8). Size structure of northern pike has increased from previous surveys. The PSD, PSD-P, and PSD-M were greater than previous surveys. There were 20 males, 42 females, and 5 northern pike of unknown sex. Mean length of northern pike (sexes pooled) from fyke netting was 20.9 in (SE=0.6), northern pike ranged in length from 9.4 to 40.3 in. The mean length of male northern pike was 18.8 in (SE=0.5) and mean length of female northern pike was 22.2 in (SE=0.7). Northern pike *Wr* was 104 which suggested the northern pike are in good condition.

Northern pike had slow growth rates. Mean length at age for northern pike (sexes pooled) was less than the Barron and Polk County and the Northern Region averages across most ages (Table 4). Age 3 to 7 northern pike from Pipe and North Pipe lakes were approximately 2.3 in less than the average length northern pike from Barron and Polk counties, and 0.2 in less than the Northern Wisconsin average over those same ages. The mean lengths at age reported for northern pike in this survey were similar to those

from the 1995 survey. The von Bertalanffy growth model was not able to produce a logical L_{inf}.

Northern pike were long-lived and had a low mortality rate. Ages ranged from 1 to 12. The catch curve regression model (fitted to age 4 to age 12) estimated annual mortality to be 27.8% (Z= -0.33, R^2 = 0.76; Figure 9).

Late spring electrofishing

Largemouth Bass. We collected and marked 696 adult (≥ 8 in) largemouth bass by fyke netting and electrofishing (Figure 10). Bass were given differential fin clips between the two lakes, but due to the amount of movement between the lakes, we only determined the population estimate for both lakes combined. The adult largemouth bass population estimate for Pipe and North Pipe lakes combined was 3,442 or 10.1 fish/acre (95% C.I. = 2,597-4,287; Figure 11), which was an increase from the 2004 survey when it was estimated at 3,056 or 8.9 fish/acre (95% C.I. 2,101-4,010).

There were 253 largemouth bass collected during the late spring electrofishing survey. The catch rate of largemouth bass (≥ 8 in) was 35.2 fish/mile for both lakes combined (Figure 12; 32.2 fish/mile in Pipe Lake and 45.0 fish/mile in North Pipe Lake). The catch rate of largemouth bass has increased during each late spring electrofishing survey since 1995. The catch rate of largemouth bass in Pipe and North Pipe lakes was high for small bass and low for large bass when compared to similar waterbodies in Wisconsin. The CPE8 (35.2 fish/mile), CPE12 (9.6 fish/mile), and CPE15 (0.7 fish/mile) were in the 76th, 60th, and 18th percentiles, respectively.

The largemouth bass population continues to have poor size structure. Largemouth bass PSD was 32 ±4, and the PSD-P was 1 ±1 (Figure 13). The PSD and PSD-P are similar to those from the 2011 survey, but were less than the 1995 and 2004 surveys. When compared to similar waterbodies in Wisconsin, largemouth bass PSD was poor and was in the 8th percentile. Largemouth bass ranged in length from 5.4 to 18.3 in, and the mean length was 11.4 in. Largemouth bass *Wr* was 102, which suggests the largemouth bass were in good condition.

Growth rates of largemouth bass have decreased in Pipe and North Pipe lakes. The mean length at age was at an all-time low for all ages when compared to the 1995

and 2004 surveys (Table 5). The mean length at age from age 4 to age 8 largemouth bass averaged 2.3 in less than those from 2004, and 1.3 in less than those from 1995. Mean length at age for all age classes were also less than those from the Barron and Polk County average, and the Northern Region average.

The predicted length infinity (L_{inf}) from the von Bertalanffy growth model was 20.2 in (Figure 14).

Largemouth bass had high mortality rates. Ages of largemouth bass ranged from 2 to 11. The catch curve regression model (fitted to age 4 to age 12) estimated annual mortality to be 52.5% ($Z= -0.74$, $R^2 = 0.86$; Figure 15).

Smallmouth Bass. Smallmouth bass were less abundant than largemouth bass. There were 13 adult (≥ 8 in) smallmouth bass marked during the early spring bass marking, and there was 24 collected during the late spring electrofishing survey and two of the fish were marked (Figure 16). The adult smallmouth bass population estimate for Pipe and North Pipe lakes combined was 121 fish or 0.4 fish/acre (95% C.I. = 3-239; Figure 11). Due to the low number of fish collected, this is not a precise estimate (CV=0.50); however, it is apparent the smallmouth bass population has declined since the 1995 and 2004 surveys.

The catch rate of smallmouth bass (≥ 8 in) for both lakes combined during the late spring electrofishing survey was 3.3 fish/mile, which also declined between the 1995 (17.2 fish/mile) and 2004 (8.8 fish/mile) surveys (Figure 17). The catch rate of smallmouth bass (≥8 in) was greater in Pipe Lake (3.7 fish/mile) than in North Pipe Lake (2.2 fish/mile) during the late spring electrofishing survey. The catch rate of smallmouth bass in Pipe and North Pipe lakes was average when compared to similar waterbodies in Wisconsin. The CPE8 (3.3 fish/mile), CPE12 (1.2 fish/mile), and CPE15 (0.6 fish/mile) were in the 64th, 41st, and 61st percentiles, respectively.

Smallmouth bass had low size structure. Smallmouth bass PSD was 46 ±16, and the PSD-P was 19 ±13 (Figure 18). The PSD was less than previous surveys and PSD-P is less than all but one (1995) survey. The smallmouth bass PSD was in the 15th percentile for similar waterbodies in Wisconsin. Smallmouth bass ranged in length

from 7.5 to 18.6 in, and the mean length was 11.3 in. Smallmouth bass *Wr* was 102, which suggests they were in good condition.

Smallmouth bass had moderate growth rates in Pipe and North Pipe lakes. The mean length at age were greater than the 1995 survey, but less than the 2004 survey. The mean length at age from age 3 to age 8 averaged 0.4 in more than those from 1995, but 2.9 in less than those from 2004 (Table 6). Mean length at age were similar to the Barron and Polk County average, and also the Northern Region average. The predicted length infinity (L_{inf}) from the von Bertalanffy growth model was 20.9 in (Figure 19).

Ages of smallmouth bass ranged from age 3 to age 11. The catch curve regression model (fitted to age 3 to age 11) estimated annual mortality to be 25.7% (Z= -0.30, R^2 = 0.72; Figure 20).

Bluegill. There were 328 bluegill collected during the late spring electrofishing survey (Figure 21). The catch rate was 142 fish/mile in North Pipe Lake and 186 fish/mile in Pipe Lake. Total length of bluegill ranged from 1.5 to 8.8 in, and the mean length was 5.4 in.

The size structure and growth rates of bluegill in Pipe Lake were fair. The PSD was 44 ± 10 and PSD-P was 10 ± 6. Bluegill mean length at age was similar to the 1996 survey (i.e., most recent survey with bluegill aging data) and was lower than the Barron and Polk County average and the Northern Wisconsin average across nearly all ages (Table 7).

Black Crappie. There were 10 black crappie collected on North Pipe Lake, for a catch rate of 10 fish/mile (Figure 22). Length of crappie ranged from 4.2 to 10.3 in, and the mean length was 9.9 in. No black crappie were collected on Pipe Lake

Other panfish. There were 7 green sunfish sampled from Pipe Lake during the late spring electrofishing, for a catch rate of 7.0 fish/mile. The mean length was 5.3 in with a range of 2.3 to 8.0 in.

Twelve rock bass were collected for a catch rate of 2.0 fish/mile on North Pipe and 10.0 fish/mile on Pipe Lake. The mean length was 6.5 in with a range of 3.0 to 8.2 in.

Fourteen yellow perch were collected for a catch rate of 12.0 fish/mile in North Pipe and 2.0 fish/mile in Pipe Lake. The mean length of perch was 3.6 in with a range of 2.8 in to 4.9 in.

Fall Electrofishing

Walleye recruitment. There was one age-0 walleye collected during the fall electrofishing survey, but no age 1 walleye (Table 8). Catch rates of age-0 and age-1 walleye have historically been low in Pipe Lake, despite intensive stocking efforts. The only time the catch rate of age-0 walleye exceeded 7.5 fish/mile was when large fingerling walleye were stocked prior to the survey (i.e., 2009 and 2011). If the 2009 and 2011 stocking events are excluded, the average age-0 catch rate from 1989 to 2015 is 1.2 fish/mile. There is a low level of natural reproduction that occurs on Pipe Lake most years, but there has never been a strong naturally-reproduced year-class on Pipe Lake.

Fry and small fingerling stockings have failed to produce measurable year-classes. Small fingerling stocking did appear to increase the catch rate of age-0 walleye. The average age-0 catch rate when small fingerlings were stocked was 2.37 fish/mile. In contrast, the average age-0 catch rate was 0.86 fish/mile during non-stocked years or years when the survey occurred prior to a large fingerling stocking event. Comparing fall catch rates of age-0 walleye to walleye stocking indicates no consistent pattern of stronger year-classes during years with higher stocking rates.

The two highest age-1 walleye catch rates were in 2010 and 2014, both years had large fingerling stocking event the previous year.

Largemouth Bass. There were 40 largemouth bass collected between Pipe and north Pipe Lake during the fall electrofishing survey. The catch rate of largemouth bass ≥8 in was 7.2 fish/mile in North Pipe Lake and 4.1 fish/mile in Pipe Lake. The catch rate of largemouth bass ≥8 in has decreased since 2007 (Figure 23).

Summary and Discussion

The fish community of Pipe and North Pipe lakes has changed considerably over the last two decades, with the most notable changes being the walleye and smallmouth bass populations have decreased, while the largemouth bass population has greatly increased.

The walleye population has steadily declined each survey since 1989 when it was 2.1 adults/ac. The decline in the walleye population is largely driven by the lack of natural recruitment, as the last natural walleye year-class was in 1986 (Cornelius 1997); however, high exploitation may have also been a factor over this timeframe because exploitation was reported to be as high as 46% during the 1995 survey (Cornelius 1997). Nonetheless, the current walleye population (0.8 fish/ac) declined 33% from the 2004 survey (1.2 adults/ac) despite having a more protective 18 in minimum length limit, and several years of receiving large fingerling walleye instead of small fingerlings. Although there were only two year-classes (2011 and 2009; age 4 and age 6) of stocked large fingerlings that were fully recruited to the gear in this survey; however, those year-classes did not show marked increases in abundance.

Walleye had moderate size structure with few large walleye present, which was similar to previous Pipe Lake surveys (Cornelius 1997; Benike 2006). With a lower density, the growth rates of walleye have increased slightly from previous surveys. With increased growth rates, it could be possible to see more large walleye present in Pipe Lake.

The sex ratio of male:female walleye has shifted greatly in recent surveys. The male: female ratio was 0.7:1 during this survey, which is considerably less than it was in 1995 (3.3:1), and 2004 (3:1). Additionally, the sex ratio in this survey likely underestimated the female walleye in the sample because there was a fair amount of unknown sex walleye that were likely green females. If all the unknown sex walleye over 15.0 in were female, the male: female sex ratio would become 0.5:1. Healthy, naturally-reproducing walleye fisheries should have high male:female similar to the 1995 and 2004 surveys. Low density walleye populations with low male:female ratios are often considered populations that have had minimal recruitment and are on the verge of collapse.

Walleye natural reproduction does occur on Pipe Lake most years, which is atypical for Polk County lakes. However, the natural reproduction tends to occur at a very low level. There has never been a strong naturally-reproduced year-class documented on Pipe Lake. Stocking has been the main source of walleye recruitment on Pipe Lake, but stocking has had mixed success. Historically, walleye stocking consisted of small fingerling stocking. However, small fingerling stockings did not drastically increase the abundance of age-0 walleye in fall electrofishing surveys. The catch rate of age-0 walleye was 2.37 fish/mile in years small fingerlings were stocked and was 0.86 fish/mile in non-stocked years. The difference is likely negligible, and unlikely to have population-level effects. The mean catch rate of age-0 walleye has been 1.24 fish/mile from the 18 fall electrofishing surveys that have occurred from 1989-2015 (excluding the years when large fingerlings were stock prior to the survey). This is a very low catch rate, considering from 1990 to 2012 the average fall catch rate of age-0 walleye in the Ceded Territory was 31.8 fish/mile in naturally-reproducing populations and 5.6 fish/mile in stocked populations (Cichosz 2015).

The walleye stocking regime for Pipe Lake switched from small fingerlings to large fingerling because small fingerling walleye were not surviving. A potential reasoning for low survival was thought to be from predation by other species such as largemouth bass. The large fingerling walleye now stocked into Pipe and North Pipe lakes are 6-8 in long and are unlikely to be consumed by the current bass population in Pipe Lake. Since the walleye population has not increased thus far with the large fingerling stockings, it could be that largemouth bass are limiting walleye stocking success through interspecific competition, not through predation. A study by Kelling et al. (2016) concluded that largemouth bass predation was probably not a primary factor affecting walleye abundance in a set of northern Wisconsin lakes, but they did observe moderate to high diet overlap between largemouth bass and walleye which suggested the potential for competition between the two species.

Although it is still early to truly evaluate the large fingerling stocking program, the large fingerling stockings have not increased the walleye population at this point. However, one encouraging sign that should be noted was that the two highest age-1 walleye catch rates had large fingerling stocking events the previous year. A better

evaluation on the large fingerling stocking will be completed during the next comprehensive survey.

Pipe Lake is a deep, well-oxygenated lake with suitable habitat for adult walleye. Unlike most Polk County lakes, the habitat of Pipe Lake appears better suited for walleye than for largemouth bass because there is limited littoral habitat and minimal aquatic vegetation. However, the low productivity and clear water of Pipe Lake may be a limiting factor for walleye production. Walleye are better adapted for turbid water, which could partly explain why the adult walleye density in North Pipe Lake is twice that of Pipe Lake.

At this time, no changes should be made to the walleye regulation or current stocking rates. However, if the walleye population does not increase to 1.5-2 adults/acre during the next comprehensive survey, large fingerling walleye stocking should be reconsidered.

Largemouth bass were very abundant and their population had low size structure. The largemouth bass population in Pipe Lake has increased in this survey since the 2004 survey based on the population estimates and late spring electrofishing catch rates. However, it is somewhat contradictory that the catch rate of ≥8 in largemouth bass has decreased on Pipe Lake during the fall electrofishing surveys since 2007. Fall electrofishing catch rates for largemouth bass tend to be lower and more variable than spring electrofishing catch rates. Therefore, the greatest emphasis should be placed on the bass population estimates and late spring electrofishing catch rates.

The largemouth bass population increased even though the bass fishery had regulations that allowed for increased harvest of bass <14 in since 2008 (i.e., no minimum, 14-18 in protected, 1 >18 in, 3 fish bag limit since 2008; no minimum, 5 fish bag limit since 2011). With an increase in abundance, the growth rates of bass have continued to decline on Pipe Lake. The mean length at age for largemouth bass in this survey declined for nearly all ages and was at an all-time low from previous surveys. Since there was not a creel survey as part of this survey, we cannot estimate the level of largemouth bass harvested or the sizes in which they were harvested. There were low levels of bass (92 largemouth and 23 smallmouth bass) harvested during the 2004-2005 survey (Benike 2006), which was the most recent creel survey. However, the 14 in

minimum length limit protected bass during that survey. Since there was not a minimum length limit on bass in this survey, it is reasonable to assume more bass were harvested during this survey. The largemouth bass mortality rate was very high (52.5%) in this survey, which could be an indication of high harvest, but could also be influenced by the high population density. However, since the bass population has continued to increase, anglers may not be harvesting enough bass to effectively reduce their density.

Anglers are encouraged to harvest small largemouth bass, especially those less than 14 inches. If the number of small (<14 in) largemouth bass can be reduced, the size structure and growth rates of the largemouth bass population should improve. The largemouth bass fishery should continue to be managed with the no minimum length limit; however, special attention should be given to the abundance, growth, and size structure of the largemouth bass population during the next comprehensive survey.

The smallmouth bass population has changed greatly in recent years. Currently, the smallmouth bass population is considerably less than it was during the last two comprehensive surveys. Although the current smallmouth bass abundance estimate (0.4fish/ac) was not considered a precise estimate, the smallmouth population has declined greatly, especially when considering the late spring electrofishing catch rates. The present status of the largemouth and smallmouth bass populations is quite the contrast from the 1995 survey when smallmouth bass (3.5 fish/ac) were more abundant than largemouth bass (2.1 fish/ac).

Pipe Lake is one of few lakes in Polk County that had a strong smallmouth bass population. The smallmouth bass fishery has been an important local resource and was popular among anglers, as smallmouth bass were the most targeted gamefish species on Pipe Lake during the 1995-1996 and 2004-2005 creel surveys (Cornelius 1997; Benike 2006). If the largemouth bass population could be reduced through angler harvest, and the smallmouth bass population was protected with a more restrictive regulation perhaps the smallmouth bass population could increase. The last creel survey occurred before the no minimum length limit, so we are unsure of the level of harvest on smallmouth bass with the current no minimum length limit, but changing the smallmouth bass regulation to an 18 in minimum length limit should be considered. A higher length limit could protect the size structure and potentially help increase the smallmouth bass population.

Northern pike remain at a relatively low abundance in Pipe and North Pipe lakes and their population is slow-growing and long-lived. Shallow, vegetated habitat is a limited habitat in Pipe Lake, so the northern pike population likely has limited spawning habitat. The shallow, vegetated habitat (most of which is in the south bay) should continue to be protected and preserved.

The catch of black crappie was low during the late spring electrofishing survey which likely underrepresented their abundance, especially considering the crappies we observed during the daytime bass marking events. Black crappie comprise a larger component of the overall fishery for these lakes, especially in North Pipe, than we observed during the late spring electrofishing.

Black crappie in these lakes are affected by a condition referred to as "black crappie sarcoma", which results in raised red lesions on the sides of crappies. Many of the larger (>10 in) crappie observed during this survey showed symptoms of black crappie sarcoma. Currently, little is known on black crappie sarcoma. We recommend that anglers not consume crappie that display symptoms of crappie sarcoma, but instead keep and discard infected crappie away from the lake. Removing infected crappies from the population should help decrease the spread of the virus to healthy fish.

The bluegill population is fair in Pipe and north Pipe Lakes. The size structure is moderate but larger fish are present. With lower fertility, the population has lower growth rates than the Barron and Polk County average.

Pipe Lake has excellent water quality and it is likely the best lake in Polk County for water clarity. The good water quality has made it desirable for water recreation and lakeshore development. Both lakes are heavily developed, with Pipe Lake being more developed. Protecting the existing natural habitat, restoring developed shoreline, and minimizing future lakeshore development will greatly benefit the Pipe Lake fish community, and help maintain the good water quality into the future.

There have been previous habitat improvement efforts on Pipe Lake. Half log structures and fish cribs were installed in the past. Most recently, there were 12 fish stick clusters installed around the state-owned islands on Pipe Lake during the winters of 2013 and 2014. Future fish stick projects are encouraged if willing landowners are identified.

Management Recommendations

1. Maintain the walleye density between 1.5-2 fish/acre through stocking large fingerling (6-8 in) walleye at a rate of 10 fish/acre. A better assessment will be made on the relative contribution of the large fingerlings during the annual fall electrofishing surveys and the next comprehensive survey.
2. Conduct another bass population estimate in the 2024 survey. Monitor the abundance, size structure, growth and mortality rates of the largemouth bass and smallmouth bass populations.
3. Encourage continued harvest of largemouth bass less than 14 inches. Reducing the number of small largemouth bass should increase the size structure and growth rates of the population and may improve walleye stocking success.
4. Explore changing the smallmouth bass regulation to a more protective 18 in minimum length limit.
5. Lakeshore property owners should be encouraged to minimize disturbance to the lakeshore and littoral zone, to protect both fish and wildlife habitat, and water quality.

Acknowledgements

Special thanks to the Brian Spangler, Craig Landes, and Josh Kucko of the Barron field office with assistance in the field, data entry, and fish age estimation. Jeff Kampa provided a critical review of this manuscript.

Literature Cited

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447–482 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Becker, G. C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison.

Benike, H. M. 2006. Pipe and North Pipe Lake Treaty Assessment Survey, Polk County Wisconsin, 2004-2005, (MWBIC: 2490500) Wisconsin Department of Natural Resources, Internal Fisheries Management Report. Barron Field Office.

Cichosz, T. A. 2015. Wisconsin Department of Natural Resources 2013-2014 Ceded Territory Fishery Assessment Report. Administrative Report No. 78 Wisconsin Department of Natural Resources, Madison.

Cornelius, R. R. 1997. Fish Survey, Pipe Lake (2490500), Polk Co.– 1995. Wisconsin DNR memo. January 13, 1997.

Guy, C. S., R. M., Neumann, D. W. Willis, and R. O. Anderson. 2007. Proportional size distribution: a further refinement of population size structure index terminology. Fisheries 32(7):348.

Kelling, C., D. A. Isermann, B. L. Sloss and K. N. Turnquist. 2016. Diet overlap and predation between Largemouth Bass and Walleye in Wisconsin lakes using DNR barcoding to improve taxonomic resolution. North American Journal of Fisheries Management 36:621–629.

Miranda L. E., and P. W. Bettoli. 2007. Mortality. Pages 229–277 in C. S. Guy and M. R. Brown, editors. Analysis and interpretation of freshwater fisheries data. American Fisheries Society, Bethesda, Maryland.

Murphy, B. R., M. L. Brown, and T. A. Springer. 1990. Evaluation of the relative weight (Wr) index, with new applications to walleye. North American Journal of Fisheries Management 10:85–-97.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191.

von Bertalanffy, L. 1938. A quantitative theory of organic growth. Human Biology 10: 181–213.

Willis, D. W. 1989. Proposed standard length–weight equation for northern pike. North American Journal of Fisheries Management 9:203–208.

Table 1. Stocking history for Pipe and North Pipe lakes Polk County, WI, 1972-2015.

Stocking Year	Species	Size	Number Stocked	Avg. Length (in)
1972	Walleye	Small fingerling	5,200	3.0
1973	Walleye	Small fingerling	5,000	3.0
1974	Walleye	Small fingerling	5,016	3.0
1994	Walleye	Small fingerling	4,182	3.0
1998	Walleye	Small fingerling	13,572	2.0
1999	Walleye	Small fingerling	13,500	1.3
2001	Walleye	Small fingerling	13,500	1.6
2003	Walleye	Small fingerling	17,282	2.2
2003	Walleye	Small fingerling	13,500	1.6
2005	Walleye	Small fingerling	17,302	1.5
2006	Walleye	Small fingerling	12,230	2.1
2006	Walleye	Fry	684,000	0.2
2007	Walleye	Fry	680,000	0.3
2009	Walleye	Large fingerling	2,933	6.5
2011	Walleye	Large fingerling	3,450	6.2
2013	Walleye	Large fingerling	3,450	6.6
2015	Walleye	Large fingerling	2,933	7.7

Table 2. Sampling effort for the 2015 Pipe and North Pipe lakes comprehensive fisheries survey.

Date	Gear	Survey type	Effort
Apr. 3 to Apr. 10, 2015	Fyke nets	Walleye netting	74 net nights
Apr. 10, 2015	Electrofishing	Walleye recapture	6.9 miles
Apr. 29 to May 27, 2015	Electrofishing	Bass marking	15.7 hours
June 1 to June 2, 2015	Electrofishing	Bass-Panfish electrofishing	6.9 miles
Sept. 22, 2015	Electrofishing	Age-0 walleye electrofishing	6.9 miles

Table 3. Mean length (in) at age for walleye (sexes pooled) in Pipe and North Pipe lakes, 1995-2015, the Barron and Polk County average, and the northern Wisconsin (NOR) average.

Age	1995	2004	2015	Barron & Polk	NOR
1	6.9	7.3	7.8	7.5	6.4
2	11.5	—	10.2	10.9	9.5
3	14.3	15.0	12.9	13.9	11.7
4	15.9	16.8	17.0	15.6	13.8
5	16.9	16.9	17.4	17.8	15.8
6	18.9	19.7	19.8	19.0	17.5
7	19.5	20.7	22.1	20.8	19.1
8	17.6	20.0	20.1	21.8	20.5
9	19.3	21.0	23.9	22.5	21.6
10	21.1	19.7	21.2	23.3	22.7
11	23.6	—	21.1	23.9	23.7
12	19.2	20.7	22.2	25.1	24.4
13	19.0	—	26.1	25.2	25.2
14	19.7	23.5	24.9	24.8	25.8
15	—	—	—	25.6	25.6
16	—	23.1	—	25.2	25.6

Table 4. Mean length (in) at age for northern pike in Pipe and North Pipe lakes, from 1995-2015, the Barron and Polk County average, and the northern Wisconsin average.

Age	1995	2015	Barron and Polk	NOR
1	—	9.4	10.8	10.6
2	15.1	16.7	15.9	13.1
3	17.5	17.5	19.6	16.3
4	21.3	20.1	21.4	19.5
5	23.2	21.3	24.2	22.0
6	—	22.4	26.5	24.5
7	—	27.7	28.9	27.7
8	—	22.4	32.1	30.3
9	—	—	34.1	31.5
10	—	29.1	35.1	34.1
11	—	33.9	32.0	37.3
12	—	40.3	32.8	38.6

Table 5. Mean length (in) at age for largemouth bass in Pipe and North Pipe lakes, from 1995-2015, the Barron and Polk County average, and the northern Wisconsin average.

Age	1995	2004	2015	Barron & Polk	NOR
1	—	—	—	4.2	4.7
2	6.6	6.4	5.8	6.8	6.7
3	7.9	8.9	7.6	8.9	9.0
4	9.9	11.9	9.7	10.9	11.0
5	12.0	13.7	11.1	12.5	12.7
6	14.0	15.9	12.5	13.9	14.6
7	15.0	15.8	13.8	14.9	16.0
8	18.1	16.4	15.3	16.0	17.3
9	16.1	—	15.5	17.0	18.1
10	20.8	—	—	17.5	18.8
11	—	—	16.6	18.5	19.4

Table 6. Mean length (in) at age for smallmouth bass in Pipe and North Pipe lakes, from 1995-2015, the Barron and Polk County average, and the northern Wisconsin average.

Age	1995	2004	2015	Barron & Polk	NOR
1	—	8.4	—	4.2	4.7
2	5.9	11.6	—	6.8	6.7
3	8.2	12.7	8.5	8.9	9.0
4	9.8	13.6	10.0	10.9	11.0
5	12.2	15.8	12.3	12.5	12.7
6	13.4	16.2	14.8	13.9	14.6
7	14.7	15.6	—	14.9	16.0
8	15.3	17.3	15.4	16.0	17.3
9	16.1	17.4	—	17.0	18.1
10	—	16.0	17.6	17.5	18.8
11	—	—	18.5	18.5	19.4

Table 7. Mean length (in) at age for bluegill in Pipe and North Pipe lakes, from the 1995 and 2015 comprehensive surveys, the Barron and Polk County average, and the northern Wisconsin average.

Age	1995	2015	Barron & Polk	NOR
1	—	2.1	2.3	2.4
2	—	3.2	3.4	3.7
3	3.1	3.7	4.3	4.7
4	4.3	4.4	5.4	5.6
5	6.0	5.3	6.2	6.5
6	6.6	6.4	6.9	7.1
7	7.4	7.0	7.4	7.7
8	8.5	8.1	7.8	8.2
9	—	8.3	8.4	8.8

Table 8. Fall electrofishing catch rates of age-0 and age-1 walleye in Pipe and North Pipe lakes with walleye stocking history.

Stocking Year	Size Stocked	Number Stocked	Age-0 / mile	Age-1 / mile
1989			1.30	0.00
1990			—	—
1991			—	—
1992			0.72	0.00
1993			2.46	0.00
1994	Small fingerling	4,182	7.22	0.00
1995			3.48	0.00
1996			—	—
1997			—	—
1998	Small fingerling	13,572	—	—
1999	Small fingerling	13,500	0.00	—
2000			1.01	—
2001	Small fingerling	13,500	1.74	—
2002			0.14	—
2003	Small fingerling	17,282	2.75	0.00
	Small fingerling	13,500		
2004			0.00	0.29
2005	Small fingerling	17,302	0.14	0.14
2006	Small fingerling	12,230	—	—
	Fry	684,000		
2007	Fry	680,000	0.18	0.00
2008			0.29	0.00
2009	Large fingerling	2933*	7.95	0.00
2010			0.00	0.70
2011	Large fingerling	3450*	20.00	0.00
2012			—	—
2013	Large fingerling	3,450	0.29	0.14
2014			0.49	3.90
2015	Large fingerling	2,933	0.14	0.00

"*" Denotes large fingerling stocking prior to survey

"—" Denotes no sampling

Figure 1. Map of Pipe and North Pipe lakes Polk County, Wisconsin.

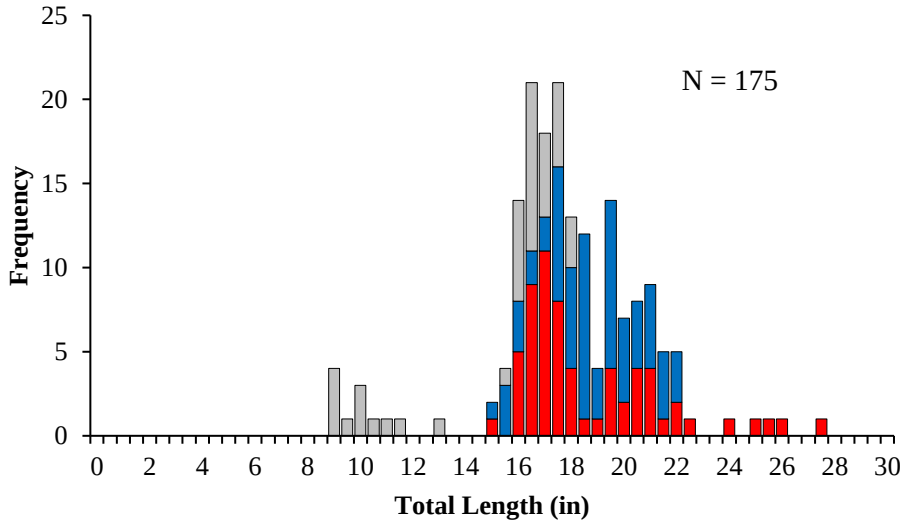

Figure 2. Length frequency histogram for walleye captured with fyke nets in in Pipe and North Pipe lakes, Polk County, WI, 2015. Gray bars represent walleye of unknown sex, blue bars represent male walleye, and red bars represent female walleye.

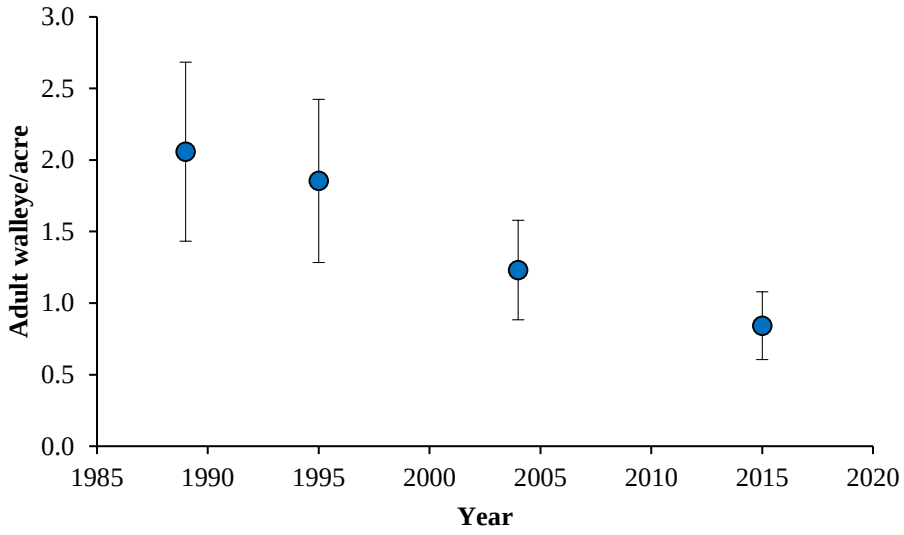

Figure 3. Population estimates for adult walleye (with 95% confidence intervals) in Pipe and North Pipe lakes, Polk County, WI, 1989-2015.

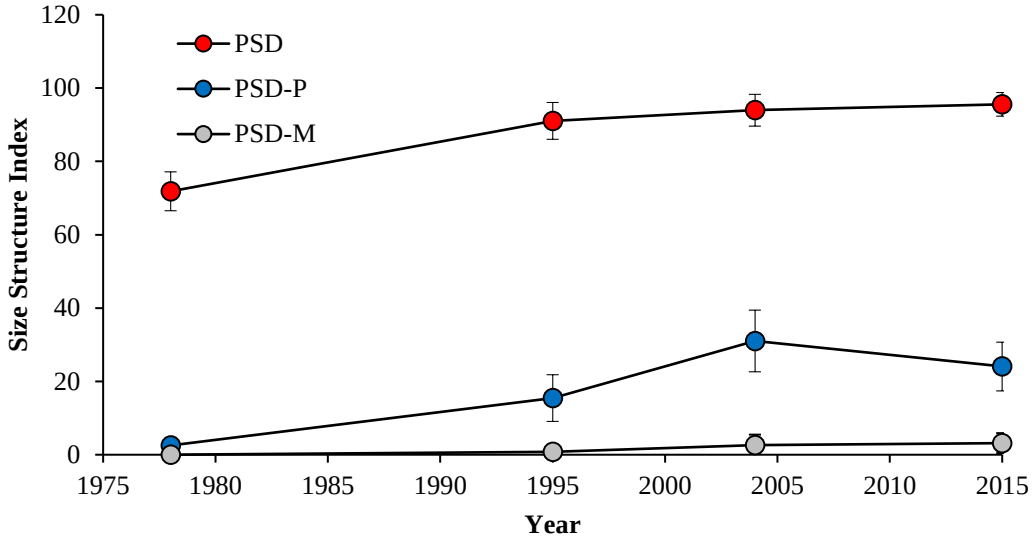

Figure 4. PSD, PSD-P, and PSD-M size structure index values (with 95% confidence intervals) for walleye collected from fyke nets in Pipe and North Pipe lakes, Polk County, WI, 1978-2015.

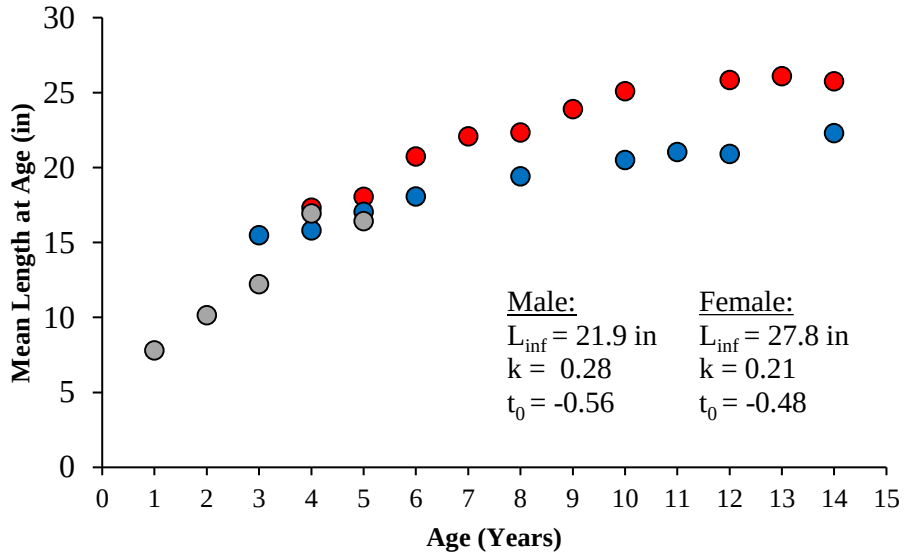

Figure 5. Mean length at age for female (red circles), male (blue circles), and unknown sex (gray circle) walleye collected from Pipe and North Pipe lakes, Polk County, WI, 2015. Mean length at age of age-1 and age-2 unknown sex walleye were included for both growth equations. L_{inf} = theoretical maximum length, k = growth coefficient, and t_0 = time at which length is zero.

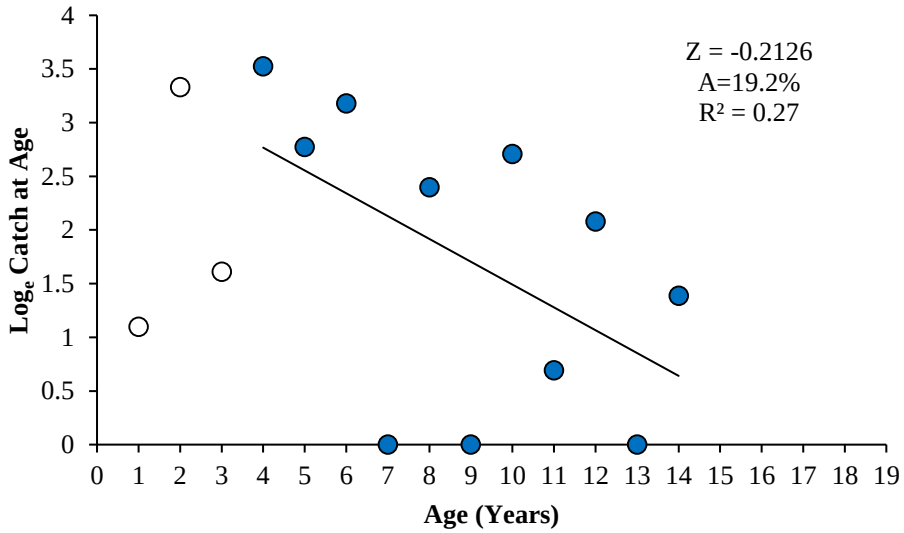

Figure 6. Number at age for walleye collected from Pipe and North Pipe lakes, Polk County, WI, 2015. A catch-curve regression estimated instantaneous annual mortality (Z) and total annual mortality (A). Age-1 to age-3 were omitted from the regression.

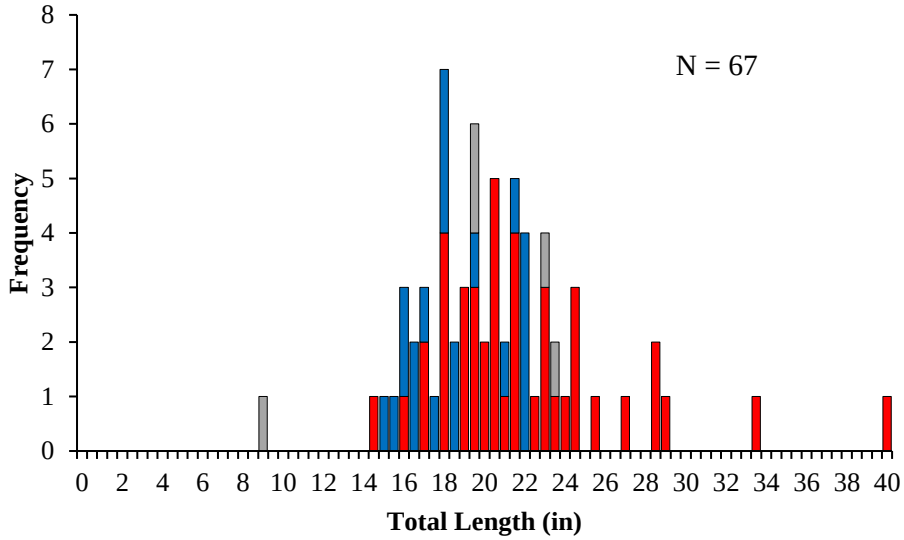

Figure 7. Length frequency histogram for northern pike captured during early spring fyke netting from Pipe and North Pipe lakes, Polk County, WI, 2015. Gray bars represent northern pike of unknown sex, blue bars represent male northern pike, and red bars represent female northern pike.

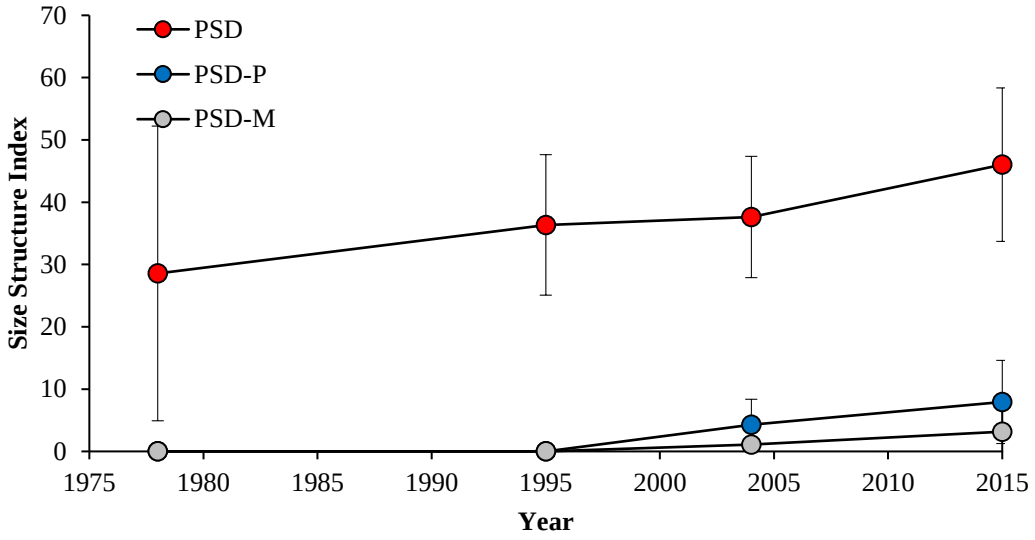

Figure 8. PSD, PSD-P, and PSD-M size structure index values (with 95% confidence intervals) for northern pike collected from fyke nets in Pipe and North Pipe lakes, Polk County, WI, 1978-2015.

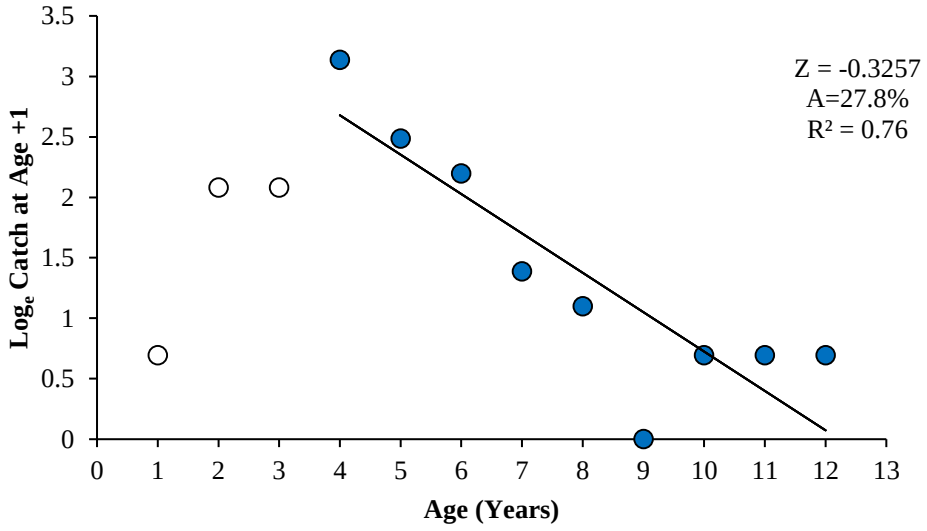

Figure 9. Number at age for northern pike collected from Pipe and North Pipe lakes, Polk County, WI, 2015. A catch-curve regression estimated instantaneous annual mortality (Z) and total annual mortality (A). Age-1 to age-3 were omitted from the regression.

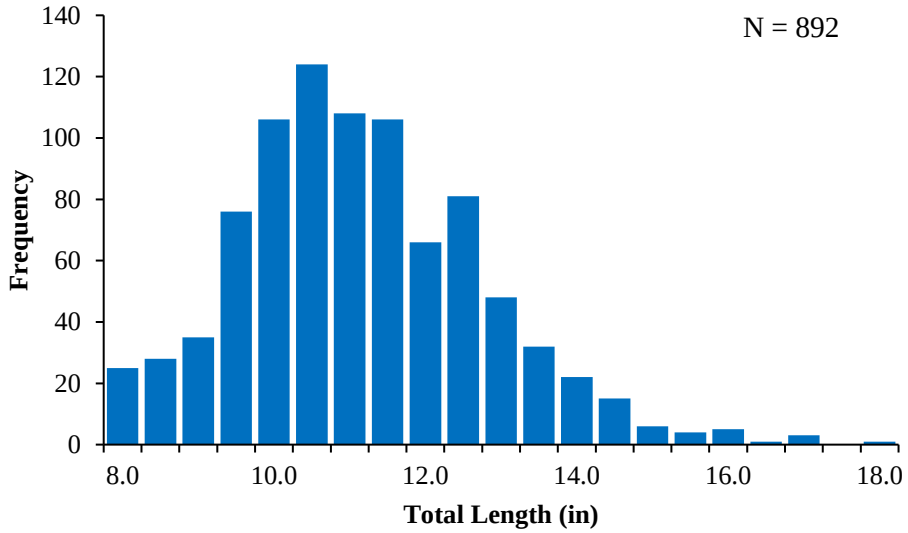

Figure 10. Length frequency histogram for adult largemouth bass (≥ 8 in) captured during spring fyke netting, bass electrofishing, and unmarked largemouth bass collected during late spring electrofishing in Pipe and North Pipe lakes, Polk County, WI, 2015.

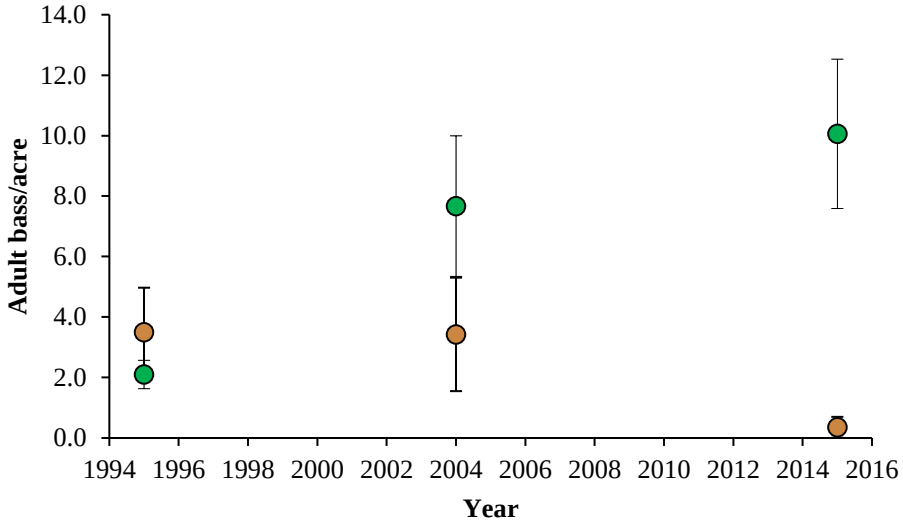

Figure 11. Population estimates for adult (≥ 8 in) largemouth bass (green circles) and smallmouth bass (brown circles; with 95% confidence intervals) in Pipe and North Pipe lakes, Polk County, WI, 1995-2015.

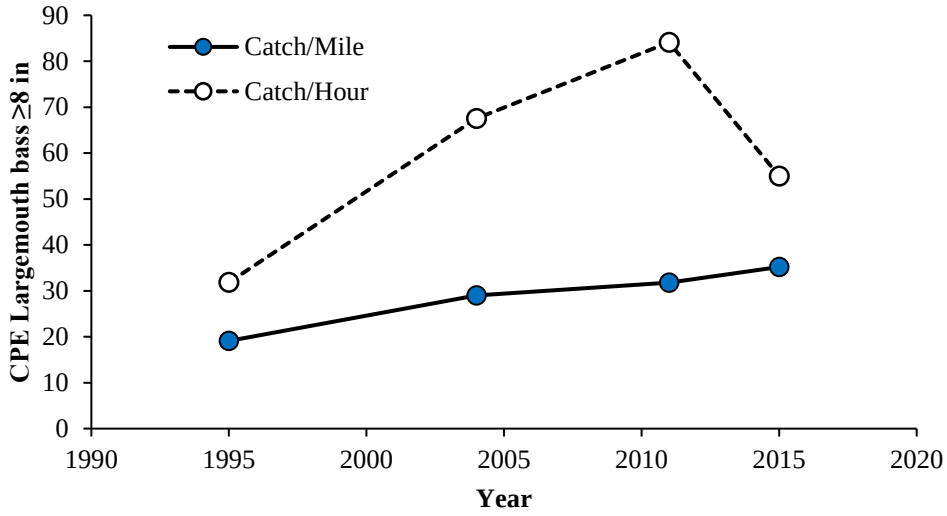

Figure 12. Catch per effort for largemouth bass collected during late spring electrofishing surveys from Pipe Lake, Polk County, WI, 1995-2015.

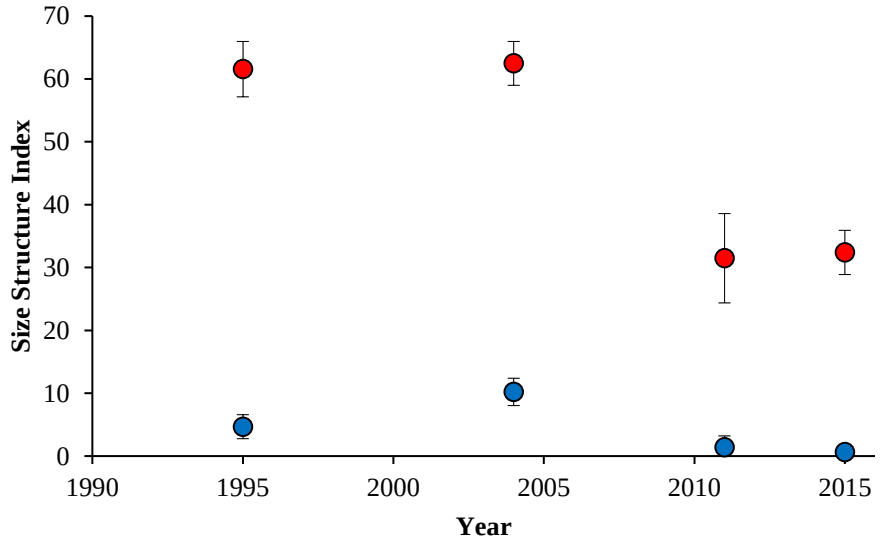

Figure 13. PSD (red circles) and PSD-P (blue circles) size structure index values (with 95% confidence intervals) for largemouth bass collected electrofishing in Pipe Lake, Polk County, WI, 1995-2015.

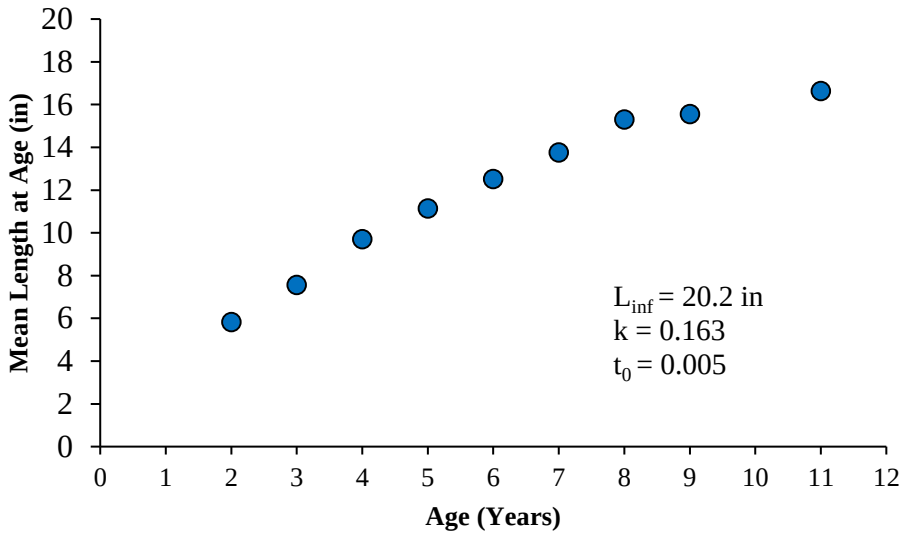

Figure 14. Mean length at age for largemouth bass collected from Pipe and North Pipe lakes, Polk County, WI, 2015. L_{inf} = theoretical maximum length, k = growth coefficient, and t_0 = time at which length is zero.

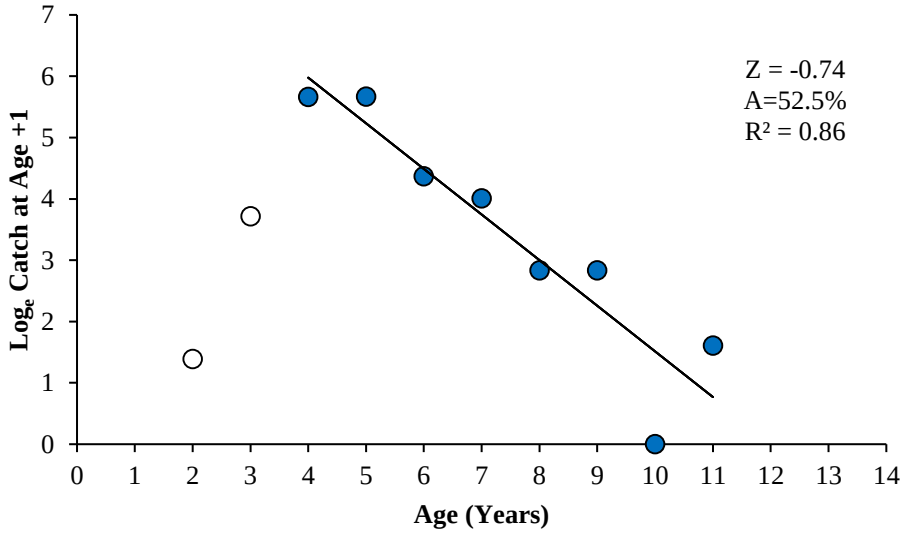

Figure 15. Number at age for largemouth bass collected from Pipe and North Pipe lakes, Polk County, WI, 2015. A catch-curve regression estimated instantaneous annual mortality (Z) and total annual mortality (A). Age-2 and age-3 were omitted from the regression.

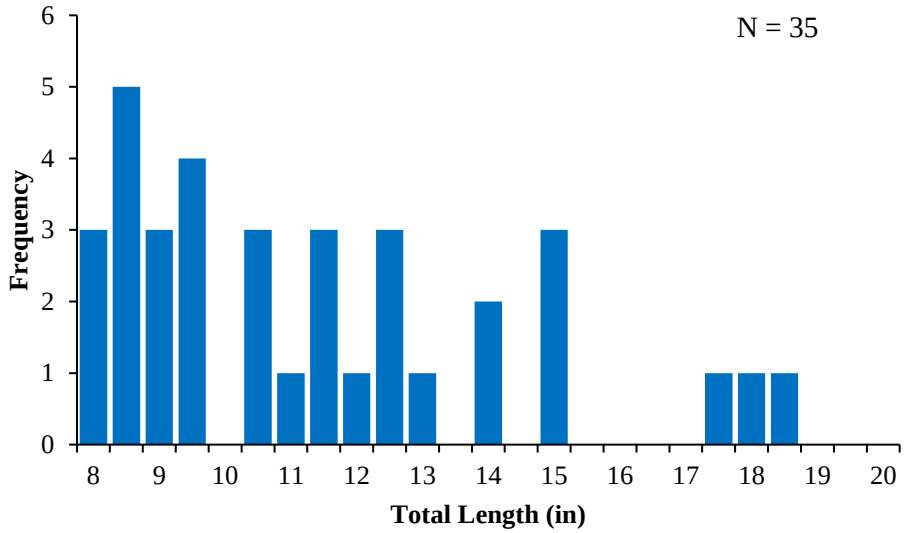

Figure 16. Length frequency histogram for adult (≥ 8 in) smallmouth bass captured spring electrofishing from Pipe and North Pipe lakes, Polk County, WI, 2015.

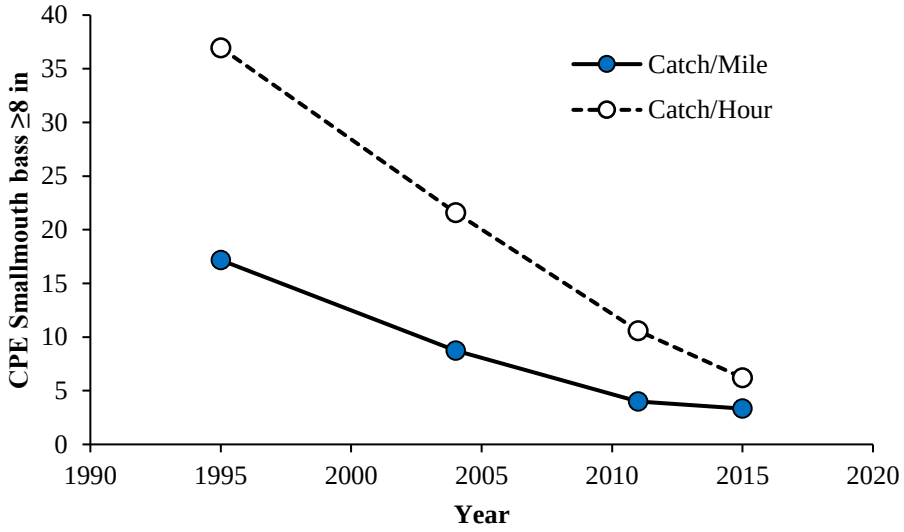

Figure 17. Catch per effort for smallmouth bass (≥8 in) collected during late spring electrofishing surveys from Pipe Lake, Polk County, WI, 1995-2015.

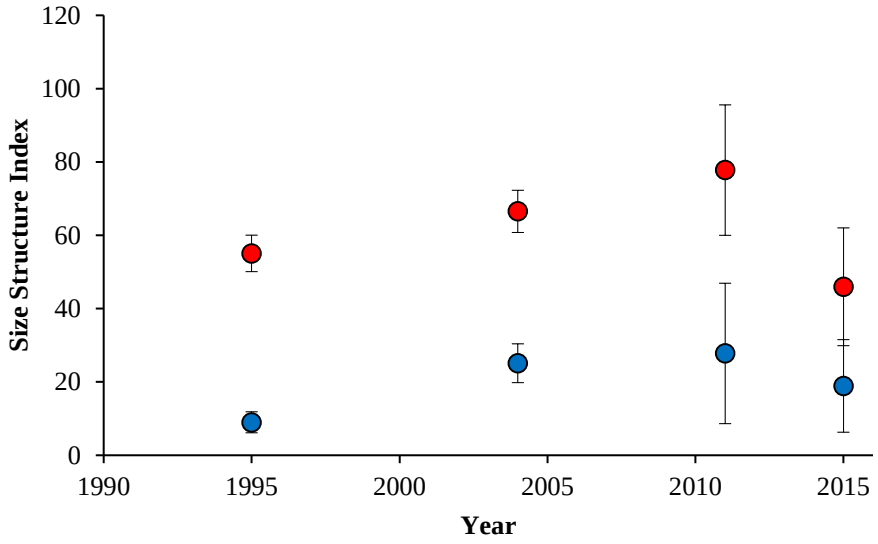

Figure 18. PSD (red circles) and PSD-P (blue circles) size structure index values (with 95% confidence intervals) for smallmouth bass collected electrofishing in Pipe Lake, Polk County, WI, 1995-2015.

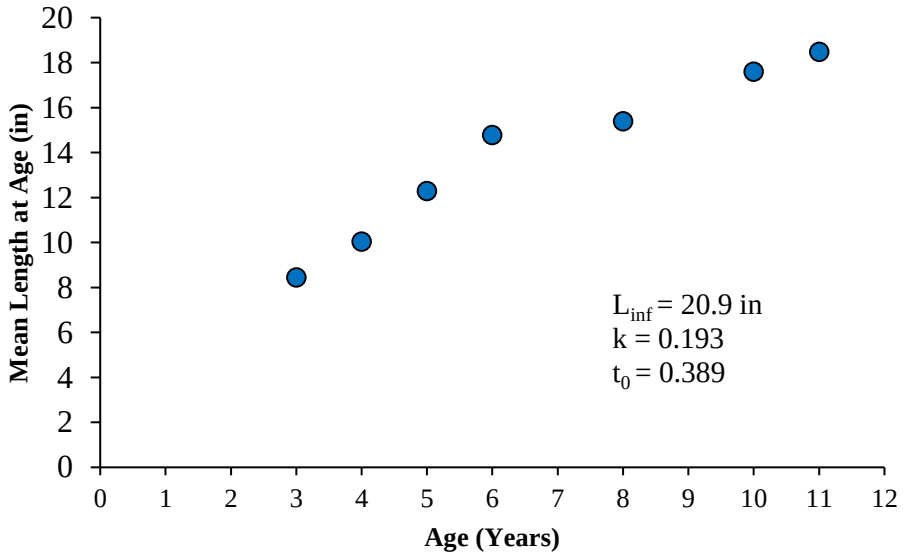

Figure 19. Mean length at age for smallmouth bass collected from Pipe and North Pipe lakes, Polk County, WI, 2015. L_{inf} = theoretical maximum length, k = growth coefficient, and t_0 = time at which length is zero.

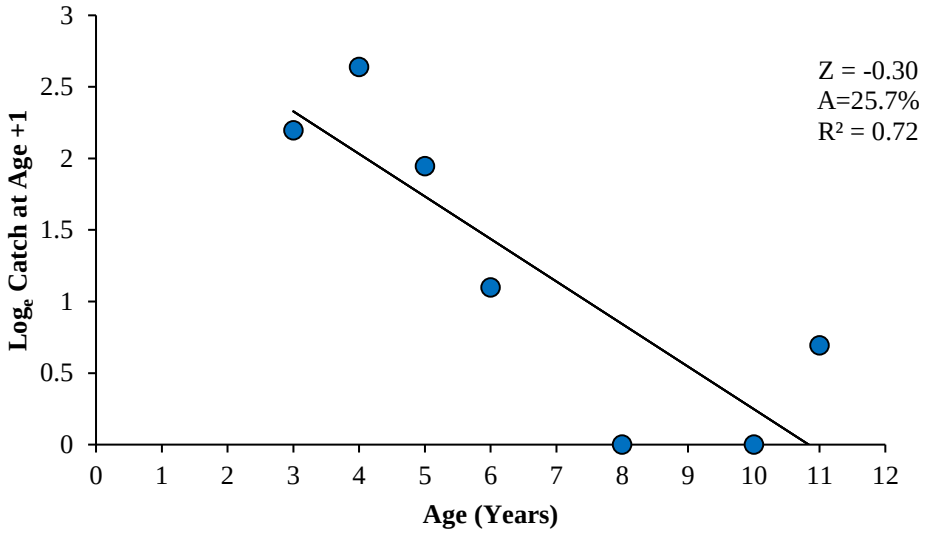

Figure 20. Number at age for smallmouth bass collected from Pipe and North Pipe lakes, Polk County, WI, 2015. A catch-curve regression estimated instantaneous annual mortality (Z) and total annual mortality (A).

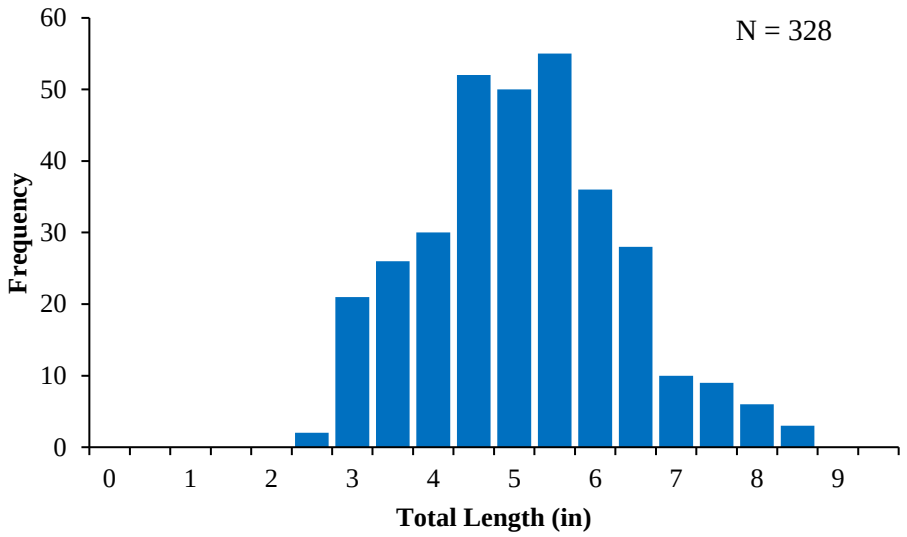

Figure 21. Length frequency histogram for bluegill captured during late spring electrofishing in Pipe and North Pipe lakes, Polk County, WI, 2015.

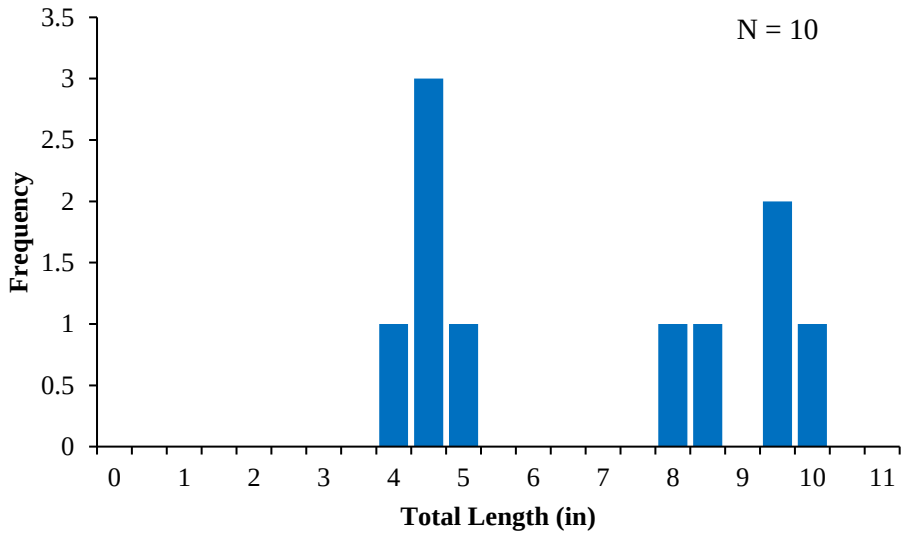

Figure 22. Length frequency histogram for black crappie captured during late spring electrofishing in North Pipe Lake, Polk County, WI, 2015.

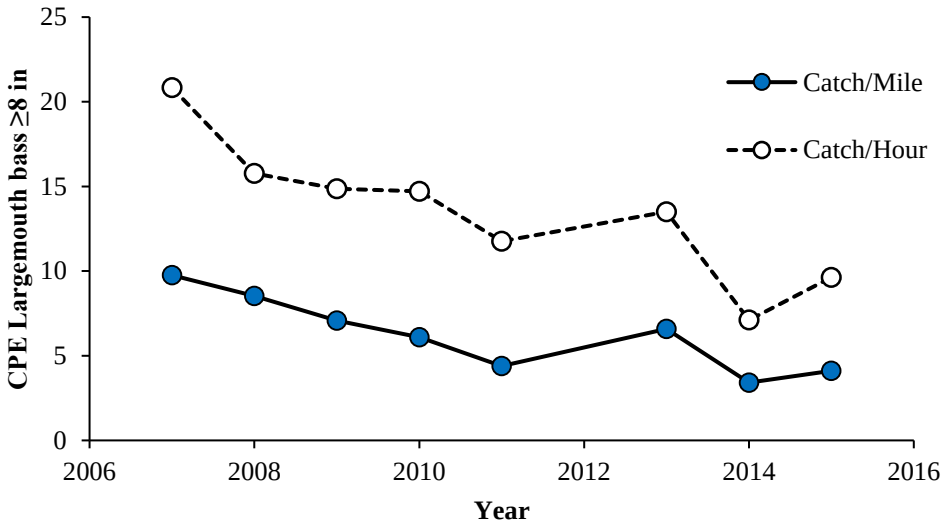

Figure 23. Catch per effort for largemouth bass collected during fall electrofishing surveys from Pipe Lake, Polk County, WI, 2007-2015.

Appendix 1. Lengths (in) used in proportional size distribution (PSD) indices for stock, quality, preferred, and memorable-sized largemouth bass, northern pike, and walleye.

Fish Species	Stock	Quality	Preferred	Memorable
Largemouth bass	8	12	15	__
Northern pike	14	21	28	34
Walleye	10	15	20	25